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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

WARTIME REPORT

ORIGINALLY ISSUED
October 1942 as
Restricted Bulletin

EFFECT OF COUNTERSUNK DEPTH ON THE TIGHTNESS OF TWO TYPES OF MACHINE-COUNTERSUNK RIVET

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EFFECT OF COUNTERSUNK DEPTH ON THE TIGHTNESS OF TWO TYPES OF MACHINE-COUNTERSUNK RIVET

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SUMMARY

An experimental investigation was conducted to determine the effect of countersunk depth on the tightness of two types of machine-countersunk flush rivet. The specimens tested in this study were simple lap joints made by two different riveting methods.

The results of this investigation indicated that roundhead rivets inserted from the back of the joint with the countersunk heads formed in the driving of the rivets produce tighter joints over a large range of countersunk depths than ordinary machine-countersunk flush rivets. For a given sheet thickness, the tightness of the rivets with the countersunk heads formed in driving is almost independent of the depth of countersink; whereas the tightness of ordinary countersunk rivets is appreciably impaired by an increase in the depth of countersink. For a given sheet thickness and depth of countersink, machine-countersunk rivets installed in the usual manner produce tighter joints if the heads of the rivets protrude above the skin surface before driving.

INTRODUCTION

In the course of a study of tightness and flushness of machine-countersunk rivets for aircraft (see reference 1), five methods of flush riveting were investigated. The present paper gives the results of an extension of this study, wherein the method of riveting that gave the highest quality with respect to both tightness and flushness is compared, for different depths of countersink, with a more commonly used method of flush riveting. The depth of countersink has been varied from a small fraction of the sheet thickness to nearly twice this thickness.

SPECIMENS AND TEST PROCEDURE

The type and size of rivet used, the angle of the countersunk hole, the side from which the rivet is inserted, and the method of riveting are shown in figures 1 and 2. The distinguishing features of the two riveting methods investigated (methods C and E in reference 1) are:

Method C.- The manufactured head of the countersunk rivet is driven with a vibrating gun while the shank end is bucked with a bar. The commercial rivet head is turned down in a lathe in order to control, for the different countersunk depths, the height h_b of the rivet head above or below the skin surface before driving. This height is designated as positive when the rivet head is above the skin surface and negative when the rivet head is below the skin surface. In this investigation, h_b was made approximately 0.005, 0.000, or -0.005 inch.

Method E.- The manufactured roundhead of the rivet is driven with a vibrating gun while the shank end is bucked with a bar. After the rivet is driven, the portion of the formed head that protrudes above the skin surface is milled off with the flush-rivet milling tool described in reference 2.

The specimens consisted of two lapped sheets of 24S-T aluminum alloy riveted together with two A17S-T aluminum-alloy rivets, as shown in figure 3. The sheets used were 0.032, 0.040, 0.051, and 0.064 inch thick.

Loads were applied to the specimens through Templin grips with a hydraulic testing machine accurate to better than one-half of 1 percent. Displacements of one sheet with respect to the other were measured on the edges of the sheets opposite the center of the riveted joint by means of two 16-power microscopes with filar micrometers. Both the displacement under load and the permanent displacement remaining after removal of the load were measured for successively increasing loads until failure occurred.

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RESULTS AND CONCLUSIONS

It was concluded in reference 1 that a comparison of the quality of machine-countersunk riveted joints on the basis of maximum load alone is not justified; the yield load as a measure of tightness is a better criterion of the strength quality of a flush-riveted joint. The yield load is defined as the shear load per rivet for which the sheets are permanently displaced an amount equal to 4 percent of the rivet diameter. This definition is arbitrary and corresponds, in a measure, to the arbitrary definition of yield point commonly specified for aircraft materials.

In figure 4 maximum load and yield load are plotted against the depth of countersink. From this figure it is concluded that:

1. Riveting method E produces flush rivets of consistently higher strength quality than riveting method C for all depths of countersink investigated.

2. For a given sheet thickness, the yield load for riveting method E is almost independent of the depth of countersink; whereas, for riveting method C, the yield load is appreciably lowered by an increase in the depth of countersink.

3. For a given sheet thickness and depth of countersink, riveting method C develops better strength qualities when h_b is positive than when h_b is negative.

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REFERENCES

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2. Gottlieb, Robert: A Flush-Rivet Milling Tool. NACA R.B., June 1942.

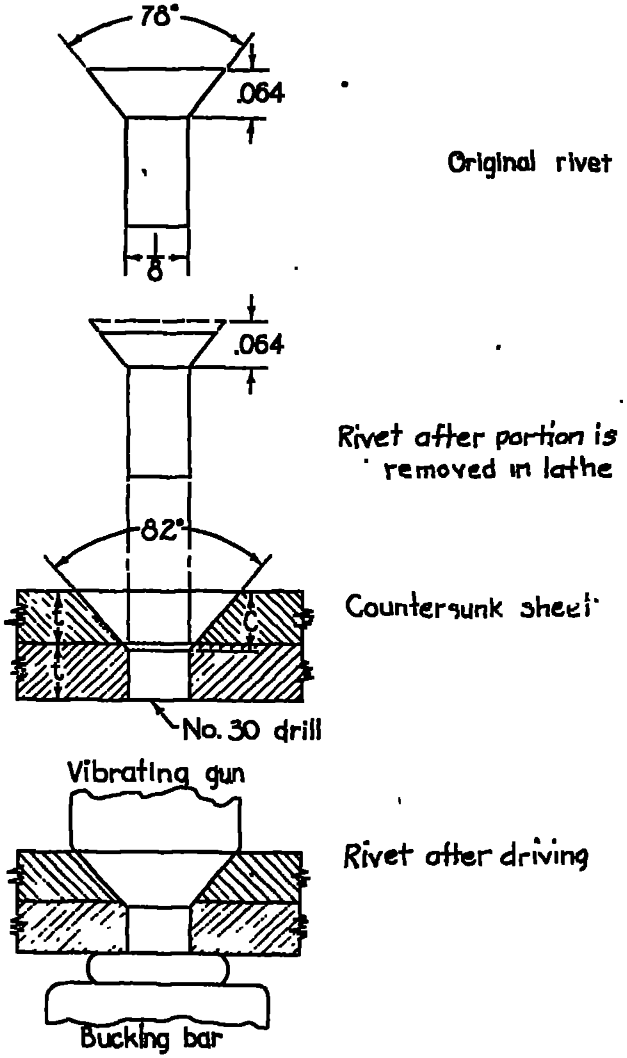

Figure 1.- Riveting method C.

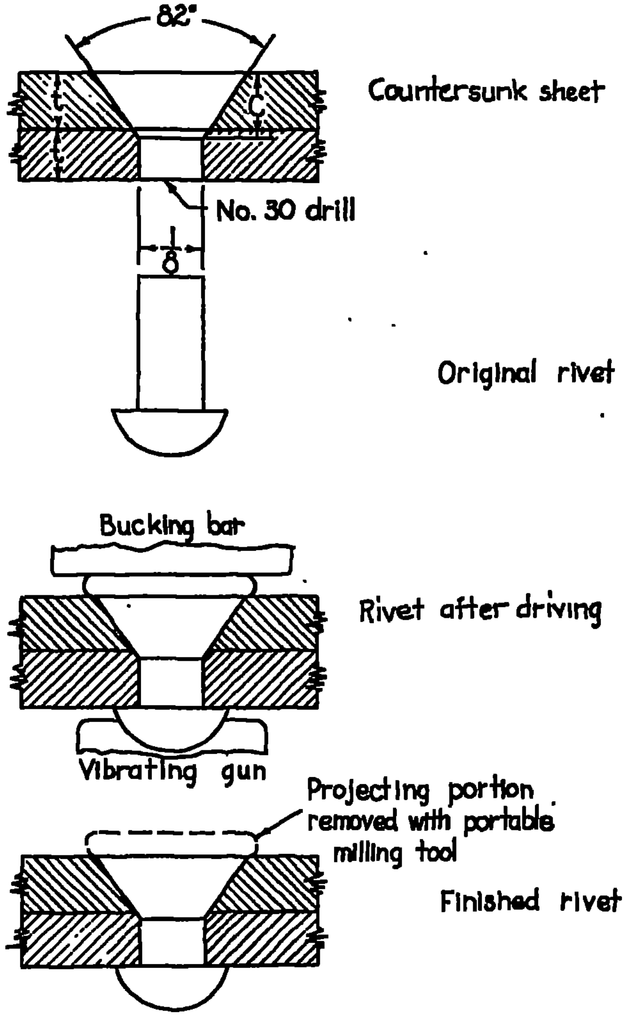

Figure 2.- Riveting method E.

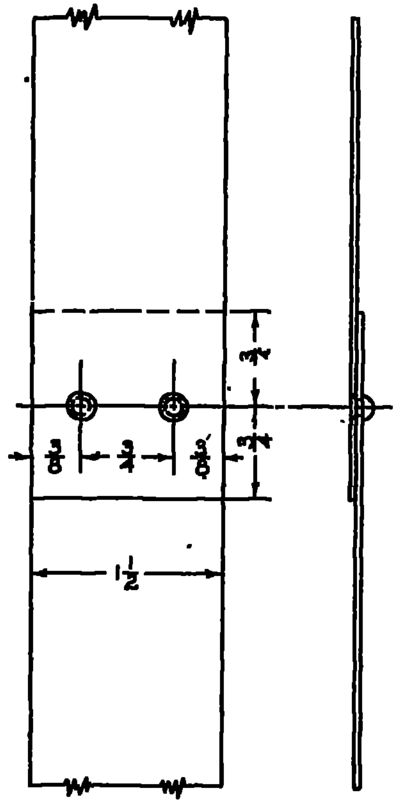

Figure 3.- Test specimen.

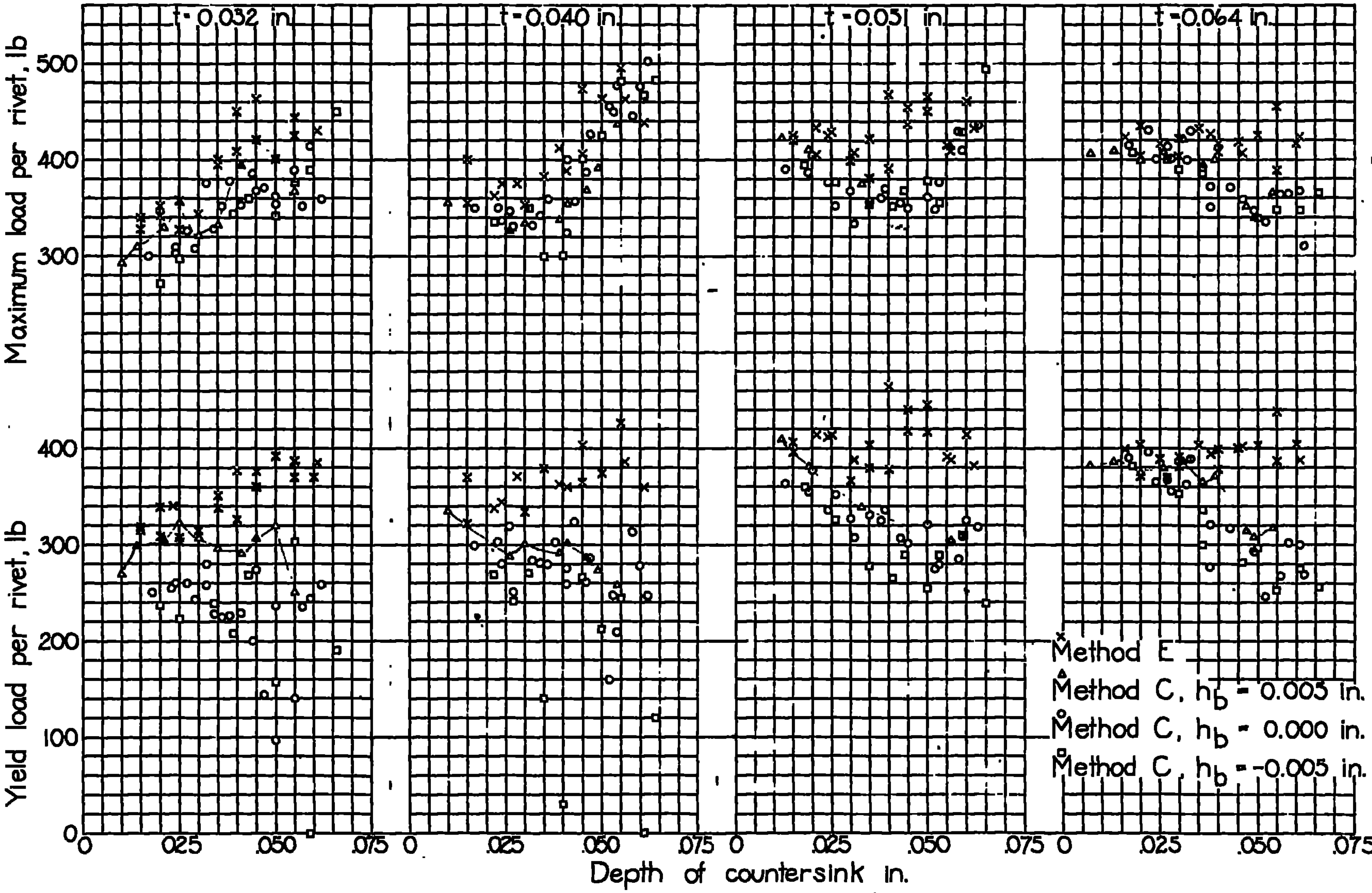

Figure 4.- Effect of countersunk depth on yield load and maximum load for riveting methods C and E.

Fig. 4